PERFORMANCE OF DIFFERENT DIGITAL ELEVATION MODEL RESOLUTION FOR THE ROMPIN RIVER BASIN

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STUDENT'S DECLARATION

I hereby declare that the work in this thesis is based on my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously or concurrently submitted for any other degree at Universiti Malaysia Pahang or any other institutions.

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ABSTRAK

Model Elevasi Digital (DEM) sesebuah garis batas air atau lembangan membentuk asas utama untuk pemodelan hidrologi dan resolusinya memainkan peranan utama dalam ramalan tepat mengenai pelbagai proses hidrologi. Kajian ini menilai kesan DEM berbeza dengan resolusi spatial bervariasi iaitu 5m Interferometric Radial Aperture Radar (IFSAR) - Digital Terrain Model (DTM) dan 30m Shuttle Radar Topography Mission (SRTM) - Digital Elevation Model (DEM) menggunakan aplikasi perisian ArcGIS untuk kajian kes Lembangan Sungai Rompin di Rompin, Pahang. Objektif kajian ini adalah untuk menggambarkan rangkaian sungai dan tadahan lembangan, dan untuk menilai prestasi SRTM-DEM 30m dan IFSAR-DTM 5m dalam menyediakan maklumat fizikal dan topografi untuk lembangan Sungai Rompin. Dari hasil kajian kes itu, diperhatikan bahawa resolusi DEM yang berbeza menghasilkan ketepatan yang berbeza. Perbezaan ralat purata berbanding dengan rangkaian sungai digital untuk IFSAR-DTM 5m didapati lebih besar berbanding dengan 30m SRTM-DEM. Kesalahan besar disebabkan oleh nilai z yang diberikan semasa proses pemulihan. Memandangkan prestasi 30m SRTM-DEM adalah berhampiran dengan 5m IFSAR-DTM, ia menunjukkan bahawa resolusi 30m cukup boleh dipercayai dalam menyediakan maklumat fizikal dan topografi Lembangan Sungai Rompin.

ABSTRACT

Digital elevation model (DEM) of a watershed forms key basis for hydrologic modelling and its resolution plays a key role in accurate prediction of various hydrological processes. This study appraises the effect of different DEMs with varied spatial resolutions namely 5m Interferometric Synthetic Aperture Radar (IFSAR) - Digital Terrain Model (DTM) and 30m Shuttle Radar Topography Mission (SRTM) - Digital Elevation Model (DEM) using ArcGIS software application for the case study of Rompin River Basin in Rompin, Pahang. The objectives of this study are to delineate river network and basin catchment, and to evaluate the performance of the 30m SRTM-DEM and 5m IFSAR-DTM in providing physical and topographical information for the Rompin river basin. From the result of the case study, it was observed that the different DEMs resolution produced different accuracies. The average error difference compared to the digitised river network for the 5m IFSAR-DTM was found out to be larger compared to the 30m SRTM-DEM. The large error was caused by the z-value assigned during the reconditioning process. Since the performance of 30m SRTM-DEM is close to the 5m IFSAR-DTM, it indicates that 30m resolution is sufficiently reliable in providing physical and topographical information of the Rompin River Basin.

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LIST OF SYMBOLS

GIS	Geographical Information System
SRTM	Shuttle Radar Topography Mission
DEM	Digital Elevation Model
IFSAR	Interferometric Synthetic Aperture Radar
DTM	Digital Terrain Model
HEC-GeoHMS	Geospatial Hydrologic Modeling Extension

LIST OF ABBREVIATIONS

GIS	Geographical Information System
SRTM	Shuttle Radar Topography Mission
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CHAPTER 1

INTRODUCTION

1.1 General

Flood problem has been a common issue in Malaysia. This country receives abundant of rainfall every year with the mean annual rainfall in the entire Peninsular Malaysia was approximately 2300mm (Wong et.al, 2009). There are two types of floods that frequently occurred in Malaysia, flash flood and monsoon flood. Monsoon usually happen from May to August at the West Coast, and November to February at the East Coast (Suhaili. et.al, 2010). Meanwhile, flash flood occurred due to high intensity of rainfall in short duration. Additionally, improper maintenance of drainage system such as drainage clogging, and under-design drainage capacity increases the chances of flash flood. Cities and towns in the East Coast of Malaysia including the Rompin district are prone to the Northeast Monsoon which induces monsoon flood. However, the areas also encounter occasional flash flood. Hence, hydrological modelling study is essential to obtain an insight on the flood event simulation of an area. Before the hydrological modelling can be performed, physical and topographical information have to extracted from the Geographical Information System (GIS).

Geographical Information System (GIS) is a new computerised technology in retrieving physical and topographical information captured by remote sensing technology. There are many GIS software applications available in the market such as ArcGIS, QGIS, GRASS GIS, TerraView, and SAGA GIS. Some of this software require annual licensing and some can be downloaded without charges. In this study, ArcGIS has been selected to delineate the Rompin river network and basin catchment. Shuttle Radar Topography Mission (SRTM) - Digital Elevation Model (DEM) and Interferometric Synthetic Aperture Radar (IFSAR) - Digital Terrain Model (DTM) were used as the raw topographical dataset for the Rompin river basin. SRTM-DEM has a resolution of 30m x

30m, while IFSAR-DTM has resolution of 5m x 5m. Larger cell grid able to work well in areas with larger variation in elevation but poorly captures detailed information at low land areas. (Reddy & Janga, 2015) stated that different resolution affects the watershed delineation, stream network and sub-basin classification Thus, for low land area higher digital model resolution is required.

The two different resolution of digital model used to delineate the river network and catchment of the Rompin River Basin were compared and their performances were evaluated. Before the delineation process, the river network was digitised based on Google satellite image. The elevation model was then reconditioned to ensure the stream position is parallel with the digitised river network. The final aim of this study is to evaluate the performance of different digital model resolution by executing the statistical analysis. The result obtained was used to identify the applicability of the different digital resolution in different topographic level to be utilised for hydrological modelling purposes.

The findings of this study can benefit engineers or water manager to extract the physical and topographical information digitally which can save time and manpower as compared to the traditional method. Several extensions that are integrated into the ArcGIS software application can assists engineers and water managers in designing matters that are related to hydrology such as drainage design. Meanwhile, local authorities and planners can also benefit from the findings which can assists them in urban planning.

1.2 Objectives

The main objective of this research is to generate geographical information mapping for the Rompin River Basin supporting by these objectives:

i) To delineate river network & basin catchments.

ii) To evaluate the performance of the 30m DEM and 5m DTM in providing physical and topographical information.

1.3 Problem Statement

Few detailed studies on the Rompin River network and basin catchments have been conducted up to this date. This is because Rompin District is still considered as a less developed area and not much economically sound activities. Nevertheless, there are several paddy schemes available throughout the river basin in which some of the plantation areas are affected by floods especially during the monsoon season. Thus, it is important to map the location of the paddy schemes area and the surrounding physical characteristics. For example, some paddy schemes maybe located at the lowland area and near to the river. When the river level rises and overflow, the access runoff floods the plantation region causing damages to the crops.

Before the introduction of digital GIS application, engineers extract the topographical information manually which is time consuming and requires manpower. In the recent decades, advancement in computer technology has ease the information extraction tasks drastically. Therefore, the used of GIS can fasten the extraction work and provide more accurate outcome. However, the level of accuracy is highly depending on the remote sensing data generated in term of digital model. For example, the larger cell grid only able to work well in areas with larger variation in elevation but tends to provide missing information in lowland areas. For this reason, the selection of digital model is important. Thus, this study compared the performance of different digital model in delineating the river network and basin catchments.

1.4 Scope of Work

This study covers only the Rompin River network and basin catchments where the boundary is within the Rompin District. The Rompin District consist of five sub-districts including Keratong, Rompin, Tioman, Pontian, and Endau. However, this study only considers three sub-district which are Keratong, Rompin, and Pontian where the Rompin River network is located.

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